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# PATENT ABSTRACTS OF JAPAN

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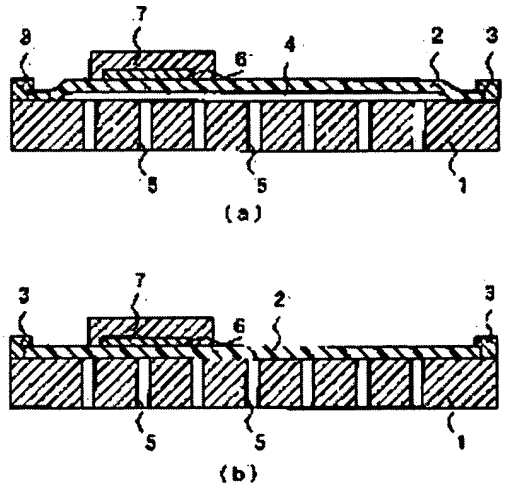
(54) POLISHER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a polisher which can change the elastic characteristic of a polishing pad without replacing the polishing pad by using a polisher on which one polishing table is provided.

SOLUTION: The edge of a polishing pad 2 is fixed so that the fluid is not leaked by a fixed member 3 on the upper surface of a polishing table 1. A wafer holder 7 which can hold the wafer 6 which is a polishing subject and also press the wafer 6 to the polishing pad 2 is provided. Plural through holes 5 are provided on the polishing table 1. The pipe connected to a pump is provided in the through hole 5. A pressure fluid 4 with an arbitrary amount or pressure can be supplied to the space surrounded by the polishing pad 2 and polishing table 1 through the pipe and through hole 5 from the pump.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the suitable polish equipment for a chemical mechanical-polishing method especially about the polish equipment of a semiconductor device.
[0002]
[Description of the Prior Art] planarizing processes, such as an interlayer film in the production process of a semiconductor integrated circuit, -- CMP (chemical mechanical polishing: Chemical Mechanical Polishing) -- the case where the technique of law is used has increased. Since an exposure margin becomes small by short wavelength-ization with the conventional optical exposure technique in order to form a detailed pattern with contraction-izing of the design rule of a semiconductor integrated circuit, and it becomes easy to be influenced of the level difference on the top face of a semiconductor integrated circuit, it is because the technique of perfect flattening of a semiconductor integrated circuit is needed. Drawing 3 is the mimetic diagram showing the 1st conventional polish equipment. Moreover, drawing 4 is drawing showing a wafer, and the sectional view in which (a) shows the condition before polish, and (b) are the sectional views showing the condition after polish.
[0003] As shown in drawing 3 , in the 1st conventional polish equipment, it consists of the rigid body and the scouring pad 2 which consists of firing polyurethane is being fixed to the top face of the pivotable polish table 1 focusing on the vertical axis. Moreover, the wafer attaching part 7 which can push a wafer 6 against a scouring pad 2 is formed, rotating focusing on a vertical axis, while holding the wafer 6 for polish. Moreover, the abrasive material supply pipe 18 which trickles an abrasive material 8 is formed above the scouring pad 2.
[0004] Moreover, the crevice 11 is formed in the field corresponding to the part in which wiring 15 is formed in alternatively [ the wafer before polish ] to semi-conductor substrate top 14, an interlayer insulation film 16 is formed in all over the, heights 10 are formed in the field corresponding to the part in which wiring 15 was formed, and wiring 15 is not formed on the top face of an interlayer insulation film 16 as shown in drawing 4 (a).
[0005] Thus, in the 1st constituted conventional polish equipment, an abrasive material 8 is dropped at the top face of the scouring pad 2 which rotates with the polish table 1 from the abrasive material supply pipe 18. And a wafer 6 is pushed against a scouring pad 2 while the wafer attaching part 7 holding a wafer 6 rotates. Thereby, the heights 10 and the crevice 11 of a wafer on top which are shown in drawing 4 (a) are ground. In order for a high pressure to join heights 10 from a crevice 11 at this time, there are more amounts by which the direction of heights 10 is ground than a crevice 11, soon, as shown in drawing 4 (b), the level difference of the heights 10 of the top face of an interlayer insulation film 16 and a crevice 11 is lost, and flattening is carried out.
[0006] However, the polish rate within a wafer side (it is also called the amount of polishes per [ which broke by polish time amount the amount of polishes when carrying out fixed time amount polish of the wafer with which the pattern is not formed ] unit time amount, and a polish rate) changes with locations within a wafer side, and a field with many amounts of polishes per unit time amount and few fields produce it. In addition, each field is called the field where a polish rate is quick, and field where a polish rate is late. Although based also on polish conditions, the center section of a wafer is specifically the field where a polish rate is late, and the periphery section of a wafer is a field where a polish rate is quick.
[0007] Moreover, the difference of the polish peak and polish minimal dose within the wafer side when grinding the wafer with which the pattern is not formed, i.e., the difference of the amount of polishes produced between the field where a polish rate is quick, and a late field, is called variation in the amount of polishes. In order to make small variation in the thickness of the insulating interlayer film which remains on a wafer, it is desirable for the variation in the amount of polishes within a wafer side to be small. In order to make small variation in this amount of polishes, there is polish equipment with which the elastic lower layer pad was prepared between the polish table and the scouring pad (JP,8-132342,A). Drawing 5 is the sectional view showing the 2nd conventional polish equipment, and drawing 6 is the

graphical representation showing the amount of variations of the amount of polishes when using the 2nd conventional polish equipment. Moreover, drawing 7 (a) thru/or (c) are the sectional views showing the polish process of a wafer, and drawing 8 is the graphical representation showing the magnitude of the level difference of the heights when using the 2nd conventional polish equipment.

[0008] As shown in drawing 5 , in the 2nd conventional polish equipment, the elastic lower layer pad 9 is formed from the scouring pad 2 between the polish table 1 and the scouring pad 2. The other configuration is the same as that of the 1st conventional polish equipment, and omits explanation.

[0009] Thus, when using the 2nd constituted conventional polish equipment and grinding a wafer 6, the deformation of the front face of a scouring pad 2 becomes the sum of the elastic deformation of a scouring pad 2, and the deformation of a lower layer pad. For this reason, since the deformation of the front face of a scouring pad 2 becomes large and the front face of a scouring pad 2 can follow in footsteps to deformation of the wafer 6 whole, such as curvature, as shown in drawing 6 , the amount of variations of the amount of polishes within a wafer side can be ground small. In addition, the "amount of polishes" shown on a graph axis of abscissa is a value set as polish equipment, in order to grind the wafer with which the pattern is not formed, and it is hereafter called the amount of conversion polishes. For example, if the wafer with which the pattern is not formed in the amount of conversion polishes of 6000A is ground, the amount of polishes will become 6000A, and when, grinding the wafer with which irregularity was formed in the front face on the other hand, in order for many pressures to join the heights, 6000A or more (for example, 8000A) polish of the heights is carried out. The "amount of polishes" shown on the axis of abscissa of the graphical representation after this shows the amount of conversion polishes altogether mentioned above.

[0010] However, while heights 12 will be ground since the deformation of the front face of a scouring pad 2 follows in footsteps of a large configuration with the detailed front face of a wafer if it grinds using the 2nd conventional polish equipment to the wafer with which the large heights 12 and the heights 13 of area were formed in the wafer top face as shown in drawing 7 (a) thru/or (c), considerable-amount polish also of the crevice 13 is carried out. For this reason, if 8000A conversion polish is performed to the wafer which has the level difference of 8000A as shown in drawing 8 for example, the level difference of about 4000A will remain in the wafer front face after polish processing.

[0011] On the other hand, there is polish equipment (henceforth the 3rd conventional polish equipment) indicated by JP,9-97772,A similarly as polish equipment aiming at raising the homogeneity of a polish rate (polish rate). The minute bag (air cell) of a large number which put pressure flow objects, such as air, into the interior is prepared between pivotable surface plates made from SUS and scouring pads, and this 3rd conventional polish equipment can control partially the deformation on the front face of a scouring pad. However, in the 3rd conventional polish equipment, if the field which does not have to carry out remainder polish like a crevice grinds to a large wafer while a part like heights to carry out flattening is large, a level difference will remain in the wafer front face after polish processing. In order to prevent this level difference remainder, it is necessary to avoid a design of a wafer which was mentioned above and by which flattening is not carried out, and the design degree of freedom of a wafer becomes low.

[0012] In order to solve the trouble in the 2nd conventional polish equipment and the 3rd polish equipment which were mentioned above, the polish equipment with which the lower layer pad shown in drawing 9 is not prepared can be used. Drawing 9 is the sectional view showing the polish equipment with which the lower layer pad is not prepared, and drawing 10 is the graphical representation showing the magnitude of the level difference of the heights when using the polish equipment shown in drawing 9 . Drawing 11 is the graphical representation showing the amount of variations of the amount of polishes when using the polish equipment shown in drawing 9 .

[0013] In the polish equipment shown in drawing 9 , since it is constituted so that it may stick to the polish table 1 on which a scouring pad 2 consists of the rigid body, the deformation of the front face of a scouring pad 2 is small. For this reason, since the front face of a scouring pad 2 does not follow in footsteps of a configuration with the detailed front face of a wafer, unlike the 2nd conventional polish equipment and the 3rd polish equipment, the amount by which the crevice 13 of a large area is ground becomes small enough, and it can prevent that a level difference remains in a wafer front face. For this reason, as shown in drawing 10 , the level difference of heights can be lost in the small amount of conversion polishes.

[0014] On the other hand, since the front face of a scouring pad 2 cannot follow in footsteps to deformation of the wafer 6 whole, such as curvature, as shown in drawing 11 , the amount of variations of the amount of polishes becomes large as compared with the 2nd conventional polish equipment with which the lower layer pad was prepared. For example, when 6000A conversion polish is performed, the amount of variations of the amount of polishes exceeds 2000A, until the level difference formed in the field where a polish rate is late is lost.

[0015] From having mentioned above, grind first with the polish equipment with which the wafer is not prepared in the lower layer pad, and a level difference is made small within limits by which the amount of variations within a wafer side is permitted. Next, the approach of making a level difference small, i.e., the approach of grinding using the scouring pad with which elasticity differs (using properly), can be further considered in the condition that the amount of variations

within a wafer side is small, by grinding with the polish equipment with which lower layer Bud was prepared. Drawing 12 is the graphical representation showing the magnitude of the level difference of the heights when using both polish equipments with which the polish equipment and the lower layer pad with which the lower layer pad is not prepared were prepared. Drawing 13 is the graphical representation showing the amount of variations of the amount of polishes when using both polish equipments with which the polish equipment and the lower layer pad with which the lower layer pad is not prepared were prepared.

[0016] For example, if it grinds with the polish equipment with which lower layer Bud was prepared after the polish equipment with which the wafer is not prepared in the lower layer pad performs 2000A conversion polish first, as shown in drawing 12 While being able to lose a level difference in the amount of conversion polishes of 8000A also to the wafer with which the heights and the crevice of the large area which has the level difference of 8000A were formed As shown in drawing 13 , as compared with the case (refer to drawing 11 ) where only the polish equipment with which the lower layer pad is not prepared is used, the amount of variations of the amount of polishes can be made small.

[0017]

[Problem(s) to be Solved by the Invention] however, in the approach mentioned above, since elasticity needs a scouring pad different, respectively, when using one polish equipment, the scouring pad with which elasticity differs is exchanged and it corresponds -- ******** (elasticity can be changed by changing the hardness of the scouring pad itself or choosing the existence of use of a lower layer pad) -- there is a trouble that exchange of a scouring pad takes time and effort.

[0018] On the other hand, when using two polish equipments, the area which equipment installation takes has the trouble of being required, by two sets. Although it can also respond using the polish equipment with which two or more polish tables were prepared, the area which equipment installation takes also in this case is not more widely [ than one set ] desirable.

[0019] This invention is made in view of this trouble, and the polish equipment with which one polish table was prepared is used, and it aims at offering the polish equipment to which the elasticity of a scouring pad can be changed, without exchanging scouring pads.

[0020]

[Means for Solving the Problem] The polish equipment concerning this invention is polish equipment which performs flattening of the front face of said semi-conductor wafer by carrying out relative motion, contacting the front face of a scouring pad and the front face of a semi-conductor wafer which were prepared on the polish table. It is characterized by having a means to stick the edge and said polish table of said scouring pad so that space may be formed between said scouring pads and said polish tables, and a fluid supply means to supply a pressure flow object in said space.

[0021] The circulation hole is formed in said polish table, and said fluid can make it the configuration supplied in said space through this circulation hole. Moreover, a means to stick the edge and said polish table of said scouring pad can be used as the support member which supports the edge and said polish table of said scouring pad, and is fixed.

[0022] Furthermore, it is desirable when a suction means to turn said scouring pad to said polish table, to attract it through said circulation hole of said polish table, and to stick said scouring pad on said polish table is established.

[0023] Furthermore, said polish table may be prepared pivotable focusing on the vertical axis, said semi-conductor wafer is held and the pivotable wafer attaching part may be prepared again focusing on the vertical axis.

[0024] In this invention, a pressure flow object can be supplied in a scouring pad, a polish table, and the space of a between using a fluid supply means. For this reason, when performing flattening of the front face of a semi-conductor wafer by carrying out relative motion, contacting the front face of a scouring pad, and the front face of a semi-conductor wafer, the elasticity in the front face of a scouring pad can be changed by changing the amount of supply or the supply pressure of a pressure flow object. Therefore, without applying the time and effort of exchanging for the scouring pad with which elasticity differs, or preparing other pads between a scouring pad and a polish table, it can grind in the condition that the deformation of the front face of a scouring pad is small, first, next the deformation of the front face of a scouring pad can grind in the large condition. For this reason, flattening can be carried out by grinding first, so that a level difference may be lost, next making variation small and grinding it, without leaving a level difference to the front face of a semi-conductor wafer.

[0025] Moreover, if a suction means to turn a scouring pad to a polish table, to attract it through the circulation hole of a polish table, and to stick a scouring pad on a polish table is established, a scouring pad can be stuck on a polish table with this suction means, and, thereby, it can change into the condition that the front face of a scouring pad cannot deform the elasticity of a scouring pad most easily.

[0026]

[Embodiment of the Invention] Hereafter, the polish equipment concerning the example of this invention is concretely explained with reference to an attached drawing. Drawing 1 is the sectional view showing the polish equipment concerning the example of this invention. Drawing 2 is drawing showing the polish equipment concerning the example

of this invention, and they are the sectional view in which (a) shows the condition that the pressure flow object was supplied, and the sectional view in which, as for (b), a scouring pad shows the condition of having stuck to the polish table. As shown in drawing 1 and 2, in the polish equipment of this example, it consists of the rigid body and the scouring pad 2 is formed in the top face of the pivotable polish table 1 focusing on the vertical axis. The edge and the polish table 1 of this scouring pad 2 are being fixed so that it may be supported by the holddown member 3 and a fluid may not leak. That is, when a fluid is supplied to the space surrounded by the polish table 1 and the scouring pad 2, a fluid leaks from the edge of a scouring pad 2. Moreover, the wafer attaching part 7 which can push a wafer 6 against a scouring pad 2 is formed, rotating focusing on a vertical axis, while holding the wafer 6 for polish. Moreover, the abrasive material supply pipe (neither is illustrated) which trickles an abrasive material is formed above the scouring pad 2.

[0027] Furthermore, as shown in drawing 2 (a), two or more circulation holes 5 are formed in the polish table 1, the pipe (neither is illustrated) connected to the pump is prepared in this circulation hole 5, and the amount of arbitration or the pressure flow object 4 of a pressure can be supplied now to the space surrounded by the scouring pad 2 and the polish table 1 through a pipe and the circulation hole 5 from a pump. Moreover, the pressure flow object 4 is sampled through the circulation hole 5 and a pipe, further, a scouring pad 2 can be turned to the polish table 1, and can be attracted, and it can be made to stick to the top face, as shown in drawing 2 (b) now.

[0028] Thus, in the polish equipment of constituted this example, first, as shown in drawing 2 (b), using a pump, a scouring pad 2 is turned to the polish table 1, and is attracted, and a scouring pad 2 is stuck on the polish table 1. Elasticity can be changed so that the deformation of the front face of a scouring pad 2 may become the smallest by this. A wafer 6 is ground using the polish equipment of this condition. An abrasive material is dropped at the top face of the scouring pad 2 which specifically rotates with the polish table 1 from an abrasive material supply pipe. And a wafer 6 is pushed against a scouring pad 2 while the wafer attaching part 7 holding a wafer 6 rotates. Thereby, the front face of a wafer 6 is ground. At this time, the deformation of the front face of a scouring pad 2 is the elastic deformation of scouring pad 2 the very thing, and since it is small, when the area of the heights of the front face of a wafer 6 and a crevice is large, it can lose a level difference.

[0029] Next, the pressure flow object 4 is supplied to the space between a scouring pad 2 and the polish table 1 through the circulation hole 5 with a pump. Thereby, elasticity can be changed so that the deformation of the front face of a scouring pad 2 may become large. A wafer 6 is ground using the polish equipment of this condition. Although the front face of a wafer 6 is ground similarly by this, the deformation of the front face of a scouring pad 2 is the sum of the elastic deformation of scouring pad 2 the very thing, and the deformation of the pressure flow object 4, and since it is large, it can make variation in the amount of polishes small. In addition, the deformation of the front face of a scouring pad 2 changes by changing the amount of supply and the supply pressure of a pressure flow object. That is, the elasticity of a scouring pad changes.

[0030] Thus, in this example, the polish equipment with which one polish table was prepared is used, and the elasticity of a scouring pad can be changed, without exchanging scouring pads. For this reason, flattening can be carried out by grinding first, so that a level difference may be lost, next making variation small and grinding it, without leaving a level difference to the front face of a wafer 6.

[0031] In addition, in this example, although deformation of the front face of a scouring pad 2 is made small and the wafer is ground by sticking a scouring pad on a polish table, in this invention, without sticking not only this but the scouring pad 2 on the polish table 1, by making small the amount of supply or the supply pressure of a pressure flow object, deformation of the front face of a scouring pad 2 may be made small, and a wafer may be ground.

[0032]

[Effect of the Invention] The elasticity of a scouring pad can be changed without applying the time and effort of exchanging for the scouring pad with which elasticity differs, or preparing other pads between a scouring pad and a polish table according to this invention, as explained in full detail above. When it grinds in the condition that the deformation of the front face of a scouring pad is small, thereby first, next the deformation of the front face of a scouring pad grinds in the large condition, flattening can be carried out without leaving a level difference to the front face of a semi-conductor wafer.

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[Translation done.]

* NOTICES *



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CLAIMS

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[Claim(s)]
[Claim 1] The polish equipment characterized by to have a means stick the edge and said polish table of said scouring pad in the polish equipment which performs flattening of the front face of said semi-conductor wafer by carrying out relative motion so that space may form between said scouring pads and said polish tables while contacting the front face of a scouring pad and the front face of a semi-conductor wafer prepared on the polish table, and a fluid supply means supply a pressure-flow object in said space.
[Claim 2] Polish equipment according to claim 1 characterized by forming the circulation hole in said polish table, and supplying said fluid in said space through this circulation hole.
[Claim 3] A means to stick the edge and said polish table of said scouring pad is polish equipment according to claim 1 or 2 characterized by being the support member which supports the edge and said polish table of said scouring pad, and is fixed.
[Claim 4] Polish equipment given in claim 1 characterized by having a suction means to turn said scouring pad to said polish table, to attract it through said circulation hole of said polish table, and to stick said scouring pad on said polish table thru/or any 1 term of 3.
[Claim 5] Said polish table is polish equipment given in claim 1 characterized by being prepared pivotable focusing on a vertical axis thru/or any 1 term of 4.
[Claim 6] Polish equipment given in claim 1 characterized by holding said semi-conductor wafer and preparing the pivotable wafer attaching part focusing on a vertical axis thru/or any 1 term of 5.

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[Translation done.]

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the polish equipment concerning the example of this invention.
[Drawing 2] It is drawing showing the polish equipment concerning the example of this invention, and they are the sectional view in which (a) shows the condition that the pressure flow object was supplied, and the sectional view in which, as for (b), a scouring pad shows the condition of having stuck to the polish table.
[Drawing 3] It is the mimetic diagram showing the 1st conventional polish equipment.
[Drawing 4] It is drawing showing a wafer and the sectional view in which (a) shows the condition before polish, and (b) are the sectional views showing the condition after polish.
[Drawing 5] It is the sectional view showing the 2nd conventional polish equipment.
[Drawing 6] It is the graphical representation showing the amount of variations of the amount of polishes when using the 2nd conventional polish equipment.
[Drawing 7] (a) Or (c) is the sectional view showing the polish process of a wafer.
[Drawing 8] It is the graphical representation showing the magnitude of the level difference of the heights when using the 2nd conventional polish equipment.
[Drawing 9] It is the sectional view showing the polish equipment with which the lower layer pad is not prepared.
[Drawing 10] It is the graphical representation showing the magnitude of the level difference of the heights when using the polish equipment shown in drawing 9 .
[Drawing 11] It is the graphical representation showing the amount of variations of the amount of polishes when using the polish equipment shown in drawing 9 .
[Drawing 12] It is the graphical representation showing the magnitude of the level difference of the heights when using both polish equipments with which the polish equipment and the lower layer pad with which the lower layer pad is not prepared were prepared.
[Drawing 13] It is the graphical representation showing the amount of variations of the amount of polishes when using both polish equipments with which the polish equipment and the lower layer pad with which the lower layer pad is not prepared were prepared.
[Description of Notations]
1; polish table
2; scouring pad
3; holddown member
4; pressure flow object
5; feed holes
6; wafer
7; wafer attaching part
8; abrasive material
9; lower layer pad
10; heights
11; crevice
12; heights of a large area
13; the crevice of a large area
14; semi-conductor substrate
15; wiring
16; interlayer insulation film
18; abrasive material supply pipe

[Translation done.]

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（P2000－218513A）
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| Ｈ０１Ｌ　21/304 | ６２２ | Ｈ０１Ｌ　21/304 | ６２２Ｆ | |

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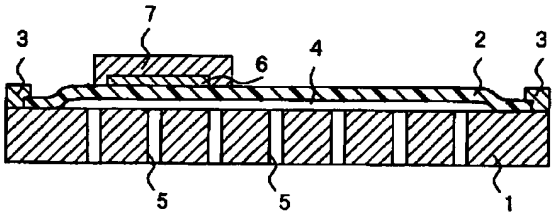
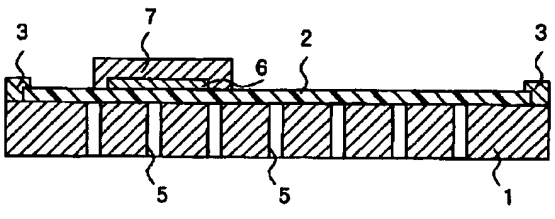
Ｆターム(参考)　３Ｃ０５８　ＡＡ０７　ＡＡ０９　ＡＡ１２　ＡＡ１５　ＢＡ０５
ＢＢ０４　ＣＢ０８　ＤＡ１７

(54)【発明の名称】　研磨装置

(57)【要約】
【課題】　１個の研磨テーブルが設けられた研磨装置を使用して、研磨パッドを交換することなく研磨パッドの弾性特性を変化させることができる研磨装置を提供する。
【解決手段】　研磨テーブル１の上面に研磨パッド２がその縁部を固定部材３により流体が漏れないように固定されている。また、研磨対象のウェハ６を保持すると共にウェハ６を研磨パッド２に押し付けることができるウェハ保持部７が設けられている。研磨テーブル１には複数の流通孔５が設けられており、この流通孔５にはポンプに接続されたパイプが設けられており、研磨パッド２と研磨テーブル１とに囲まれた空間にポンプからパイプ及び流通孔５を介して任意の量又は圧力の圧力流体４を供給することができるようになっている。



(a)



(b)

1；研磨テーブル　　5；流通孔
2；研磨パッド　　6；ウェハ
3；固定部材　　7；ウェハ保持部
4；圧力流体

1

【特許請求の範囲】

【請求項１】　研磨テーブル上に設けられた研磨パッドの表面と半導体ウェハの表面とを接触させながら相対運動させることにより前記半導体ウェハの表面の平坦化を行なう研磨装置において、前記研磨パッドと前記研磨テーブルとの間に空間を形成するように前記研磨パッドの縁部と前記研磨テーブルとを密着させる手段と、前記空間内に圧力流体を供給する流体供給手段と、を有することを特徴とする研磨装置。

【請求項２】　前記研磨テーブルに流通孔が形成されており、この流通孔を介して前記流体が前記空間内に供給されることを特徴とする請求項１に記載の研磨装置。

【請求項３】　前記研磨パッドの縁部と前記研磨テーブルとを密着させる手段は前記研磨パッドの縁部と前記研磨テーブルとを握持して固定する握持部材であることを特徴とする請求項１又は２に記載の研磨装置。

【請求項４】　前記研磨テーブルの前記流通孔を介して前記研磨パッドを前記研磨テーブルに向けて吸引し前記研磨パッドを前記研磨テーブルに密着させる吸引手段を有することを特徴とする請求項１乃至３のいずれか１項に記載の研磨装置。

【請求項５】　前記研磨テーブルは鉛直軸中心に回転可能に設けられていることを特徴とする請求項１乃至４のいずれか１項に記載の研磨装置。

【請求項６】　前記半導体ウェハを保持し鉛直軸中心に回転可能なウェハ保持部が設けられていることを特徴とする請求項１乃至５のいずれか１項に記載の研磨装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は半導体装置の研磨装置に関し、特に、化学的機械研磨法に好適な研磨装置に関する。

【０００２】

【従来の技術】半導体集積回路の製造工程における層間膜等の平坦化プロセスにＣＭＰ（化学的機械研磨：Ｃｈｅｍｉｃａｌ　Ｍｅｃｈａｎｉｃａｌ　Ｐｏｌｉｓｈｉｎｇ）法の技術が使用される場合が多くなっている。半導体集積回路のデザインルールの縮小化に伴い、微細なパターンを形成するためには、従来の光露光技術では短波長化により露光マージンが小さくなり半導体集積回路上面の段差の影響を受けやすくなるため、半導体集積回路の完全平坦化の技術が必要になるためである。図３は従来の第１の研磨装置を示す模式図である。また、図４はウェハを示す図であって、（ａ）は研磨前の状態を示す断面図、（ｂ）は研磨後の状態を示す断面図である。

【０００３】図３に示すように、従来の第１の研磨装置においては、剛体からなり鉛直軸中心に回転可能な研磨テーブル１の上面に、例えば、発砲ポリウレタンからなる研磨パッド２が固定されている。また、研磨対象のウェハ６を保持すると共に鉛直軸中心に回転しながらウェハ６を研磨パッド２に押し付けることができるウェハ保持部７が設けられている。また、研磨パッド２の上方に研磨剤８を滴下する研磨剤供給管１８が設けられている。

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【０００４】また、図４（ａ）に示すように、研磨前のウェハは半導体基板上１４に選択的に配線１５が形成されその全面に層間絶縁膜１６が形成されたものであり、層間絶縁膜１６の上面においては、配線１５が形成された部分に対応する領域に凸部１０が形成され、配線１５が形成されない部分に対応する領域に凹部１１が形成されている。

【０００５】このように構成された従来の第１の研磨装置においては、研磨テーブル１と共に回転する研磨パッド２の上面に研磨剤供給管１８から研磨剤８が滴下される。そして、ウェハ６を保持したウェハ保持部７が回転しながらウェハ６を研磨パッド２に押し付ける。これにより、図４（ａ）に示すウェハの上面の凸部１０及び凹部１１が研磨される。このとき、凹部１１より凸部１０に高い圧力が加わるため、凹部１１より凸部１０の方が研磨される量が多く、やがて、図４（ｂ）に示すように、層間絶縁膜１６の上面の凸部１０と凹部１１との段差がなくなり、平坦化される。

【０００６】しかしながら、ウェハ面内における研磨レート（パターンが形成されていないウェハを一定時間研磨したときの研磨量を研磨時間で割った単位時間当たりの研磨量、研磨速度ともいう）は、ウェハ面内の位置により異なり、単位時間当たりの研磨量が多い領域と少ない領域とが生じる。なお、夫々の領域を研磨レートが速い領域及び研磨レートが遅い領域という。研磨条件にもよるが、具体的にはウェハの中央部が研磨レートが遅い領域であり、ウェハの外周部は研磨レートが速い領域である。

【０００７】また、パターンが形成されていないウェハを研磨したときのウェハ面内における研磨最大量と研磨最小量との差、即ち、研磨レートが速い領域と遅い領域との間に生じる研磨量の差を研磨量のバラツキという。ウェハ上に残留する絶縁層間膜の厚さのバラツキを小さくするために、ウェハ面内の研磨量のバラツキが小さいことが望ましい。この研磨量のバラツキを小さくするために、研磨テーブルと研磨パッドとの間に軟質の下層パッドが設けられた研磨装置がある（特開平８－１３２３４２号公報）。図５は従来の第２の研磨装置を示す断面図であり、図６は従来の第２の研磨装置を使用したときの研磨量のバラツキ量を示すグラフ図である。また、図７（ａ）乃至（ｃ）はウェハの研磨過程を示す断面図であり、図８は従来の第２の研磨装置を使用したときの凸部の段差の大きさを示すグラフ図である。

【０００８】図５に示すように、従来の第２の研磨装置においては、研磨テーブル１と研磨パッド２との間に研磨パッド２より軟質の下層パッド９が設けられている。

それ以外の構成は従来の第１の研磨装置と同様であり、説明を省略する。

【０００９】このように構成された従来の第２の研磨装置を使用して、ウェハ６の研磨を行う場合、研磨パッド２の表面の変形量は研磨パッド２の弾性変形量と下層パッドの変形量との和になる。このため、研磨パッド２の表面の変形量が大きくなり、反り等のウェハ６全体の変形に対して研磨パッド２の表面が追随することができるため、図６に示すように、ウェハ面内の研磨量のバラツキ量を小さく研磨することができる。なお、グラフ横軸に示す「研磨量」とは、パターンが形成されていないウェハを研磨するために研磨装置に設定する値であり、以下、換算研磨量という。例えば、６０００Åの換算研磨量でパターンが形成されていないウェハを研磨すると研磨量は６０００Åとなり、一方、表面に凹凸が形成されたウェハを研磨する場合は、その凸部に圧力が多く加わるため、凸部は６０００Å以上（例えば、８０００Å）研磨される。これ以降のグラフ図の横軸に示す「研磨量」とは全て前述した換算研磨量を示す。

【００１０】しかしながら、図７（ａ）乃至（ｃ）に示すように、ウェハ上面に面積の大きい凸部１２及び凸部１３が形成されたウェハに対して、従来の第２の研磨装置を使用して研磨を行なうと、研磨パッド２の表面の変形量が大きくウェハの表面の微細な形状に追随するため、凸部１２が研磨されると共に、凹部１３も相当量研磨される。このため、図８に示すように、例えば、８０００Åの段差を有するウェハに対し、８０００Åの換算研磨を行なうと、研磨処理後のウェハ表面には、例えば、４０００Å程度の段差が残る。

【００１１】一方、同様に、研磨速度（研磨レート）の均一性を向上させることを目的とした研磨装置として、特開平９－９７７７２に開示された研磨装置（以下、従来の第３の研磨装置という）がある。この従来の第３の研磨装置は、回転可能なＳＵＳ製定盤と研磨パッドとの間に内部に空気等の圧力流体を入れた多数の微小袋（エアーセル）が設けられており、研磨パッド表面の変形量を部分的に制御できるものである。しかしながら、従来の第３の研磨装置においては、凸部のような平坦化したい箇所が広いと共に、凹部のようなあまり研磨をする必要がない領域が広いウェハに対して研磨を行なうと、研磨処理後のウェハ表面に段差が残る。この段差残りを防止するためには、上述したような平坦化されないウェハの設計を避ける必要があり、ウェハの設計自由度が低くなる。

【００１２】上述したような従来の第２の研磨装置及び第３の研磨装置における問題点を解決するためには、図９に示す下層パッドが設けられていない研磨装置を使用することができる。図９は、下層パッドが設けられていない研磨装置を示す断面図であり、図１０は、図９に示す研磨装置を使用したときの凸部の段差の大きさを示すグラフ図である。図１１は図９に示す研磨装置を使用したときの研磨量のバラツキ量を示すグラフ図である。

【００１３】図９に示す研磨装置においては、研磨パッド２が剛体からなる研磨テーブル１に密着するように構成されているため、研磨パッド２の表面の変形量が小さい。このため、研磨パッド２の表面はウェハの表面の微細な形状に追随しないため、従来の第２の研磨装置及び第３の研磨装置と異なり、大面積の凹部１３が研磨される量が十分に小さくなり、ウェハ表面に段差が残ることを防止することができる。このため、図１０に示すように、少ない換算研磨量で凸部の段差をなくすことができる。

【００１４】一方、図１１に示すように、反り等のウェハ６全体の変形に対して研磨パッド２の表面が追随できないため、研磨量のバラツキ量は下層パッドが設けられた従来の第２の研磨装置と比較して大きくなる。例えば、研磨レートが遅い領域に形成された段差がなくなるまで、６０００Åの換算研磨を行った場合、研磨量のバラツキ量は２０００Åを超える。

【００１５】上述したことから、先ず、ウェハを下層パッドが設けられていない研磨装置で研磨を行い、ウェハ面内のバラツキ量が許容される範囲内で段差を小さくして、次に、下層パッドが設けられた研磨装置で研磨を行なうことにより、ウェハ面内のバラツキ量が小さい状態で更に段差を小さくする方法、即ち、弾性特性の異なる研磨パッドを使用して（使い分けて）研磨する方法が考えられる。図１２は下層パッドが設けられていない研磨装置及び下層パッドが設けられた研磨装置の両方を使用したときの凸部の段差の大きさを示すグラフ図である。図１３は下層パッドが設けられていない研磨装置及び下層パッドが設けられた研磨装置の両方を使用したときの研磨量のバラツキ量を示すグラフ図である。

【００１６】例えば、先ず、ウェハを下層パッドが設けられていない研磨装置で２０００Åの換算研磨を行った後、下層パッドが設けられた研磨装置で研磨を行なうと、図１２に示すように、８０００Åの段差を有する大面積の凸部及び凹部が形成されたウェハに対しても、８０００Åの換算研磨量で段差をなくすことができると共に、図１３に示すように、下層パッドが設けられていない研磨装置のみを使用した場合（図１１参照）と比較して、研磨量のバラツキ量を小さくすることができる。

【００１７】

【発明が解決しようとする課題】しかしながら、上述した方法においては、弾性特性が夫々異なる研磨パッドを必要とするので、１台の研磨装置を使用する場合、弾性特性の異なる研磨パッドを交換して対応することになる（弾性特性は研磨パッド自体の硬さを変更するか、又は下層パッドの使用の有無を選択することにより変更することができる）が、研磨パッドの交換に手間がかかるという問題点がある。

【００１８】一方、２台の研磨装置を使用する場合、装置設置に要する面積は２台分必要であるという問題点がある。複数の研磨テーブルが設けられた研磨装置を使用して対応することもできるが、この場合も装置設置に要する面積は１台分より広く好ましくない。

【００１９】本発明はかかる問題点に鑑みてなされたものであって、１個の研磨テーブルが設けられた研磨装置を使用して、研磨バッドを交換することなく研磨バッドの弾性特性を変化させることができる研磨装置を提供することを目的とする。

【００２０】

【課題を解決するための手段】本発明に係る研磨装置は、研磨テーブル上に設けられた研磨バッドの表面と半導体ウェハの表面とを接触させながら相対運動させることにより前記半導体ウェハの表面の平坦化を行なう研磨装置であって、前記研磨バッドと前記研磨テーブルとの間に空間を形成するように前記研磨バッドの縁部と前記研磨テーブルとを密着させる手段と、前記空間内に圧力流体を供給する流体供給手段と、を有することを特徴とする。

【００２１】前記研磨テーブルに流通孔が形成されており、この流通孔を介して前記流体が前記空間内に供給される構成にすることができる。また、前記研磨バッドの縁部と前記研磨テーブルとを密着させる手段は前記研磨バッドの縁部と前記研磨テーブルとを握持して固定する握持部材とすることができる。

【００２２】更に、前記研磨テーブルの前記流通孔を介して前記研磨バッドを前記研磨テーブルに向けて吸引し前記研磨バッドを前記研磨テーブルに密着させる吸引手段が設けられていると好ましい。

【００２３】更にまた、前記研磨テーブルは鉛直軸中心に回転可能に設けられていてもよく、前記半導体ウェハを保持し鉛直軸中心に回転可能なウェハ保持部が設けられていてもよい。

【００２４】本発明においては、流体供給手段を使用して研磨バッドと研磨テーブルと間の空間内に圧力流体を供給することができる。このため、研磨バッドの表面と半導体ウェハの表面とを接触させながら相対運動させることにより半導体ウェハの表面の平坦化を行なう場合において、圧力流体の供給量又は供給圧力を変化させることにより、研磨バッドの表面における弾性特性を変化させることができる。従って、弾性特性の異なる研磨バッドに交換したり研磨バッドと研磨テーブルとの間に他のバッドを設けるといった手間をかけることなく、先ず、研磨バッドの表面の変形量が小さい状態で研磨を行ない、次に、研磨バッドの表面の変形量が大きい状態で研磨を行なうことができる。このため、先ず、段差をなくすように研磨し、次に、バラツキを小さくして研磨することにより、半導体ウェハの表面に段差を残すことなく平坦化することができる。



【００２５】また、研磨テーブルの流通孔を介して研磨バッドを研磨テーブルに向けて吸引し研磨バッドを研磨テーブルに密着させる吸引手段が設けられていると、この吸引手段により研磨バッドを研磨テーブルに密着させることができ、これにより、研磨バッドの弾性特性を研磨バッドの表面が最も変形し難い状態にすることができる。

【００２６】

【発明の実施の形態】以下、本発明の実施例に係る研磨装置について、添付の図面を参照して具体的に説明する。図１は本発明の実施例に係る研磨装置を示す断面図である。図２は本発明の実施例に係る研磨装置を示す図であって、（ａ）は圧力流体が供給された状態を示す断面図、（ｂ）は研磨バッドが研磨テーブルに密着した状態を示す断面図である。図１及び２に示すように、本実施例の研磨装置においては、剛体からなり鉛直軸中心に回転可能な研磨テーブル１の上面に研磨バッド２が設けられている。この研磨バッド２の縁部と研磨テーブル１とは固定部材３により握持されて流体が漏れないように固定されている。即ち、研磨テーブル１と研磨バッド２とに囲まれた空間に流体が供給された場合において、研磨バッド２の縁部から流体が漏れることがないようになっている。また、研磨対象のウェハ６を保持すると共に鉛直軸中心に回転しながらウェハ６を研磨バッド２に押し付けることができるウェハ保持部７が設けられている。また、研磨バッド２の上方に研磨剤を滴下する研磨剤供給管（いずれも図示せず）が設けられている。

【００２７】更に、図２（ａ）に示すように、研磨テーブル１には複数の流通孔５が設けられており、この流通孔５にはポンプに接続されたパイプ（いずれも図示せず）が設けられており、研磨バッド２と研磨テーブル１とに囲まれた空間にポンプからパイプ及び流通孔５を介して任意の量又は圧力の圧力流体４を供給することができるようになっている。また、図２（ｂ）に示すように、流通孔５及びパイプを介して圧力流体４を抜き取り、更に研磨バッド２を研磨テーブル１に向けて吸引しその上面に密着させることができるようになっている。

【００２８】このように構成された本実施例の研磨装置においては、先ず、図２（ｂ）に示すように、ポンプを使用して研磨バッド２を研磨テーブル１に向けて吸引し、研磨バッド２を研磨テーブル１に密着させる。これにより、研磨バッド２の表面の変形量が最も小さくなるように弾性特性を変化させることができる。この状態の研磨装置を使用してウェハ６の研磨を行なう。具体的には研磨テーブル１と共に回転する研磨バッド２の上面に研磨剤供給管から研磨剤が滴下される。そして、ウェハ６を保持したウェハ保持部７が回転しながらウェハ６を研磨バッド２に押し付ける。これにより、ウェハ６の表面が研磨される。このとき、研磨バッド２の表面の変形量は研磨バッド２自体の弾性変形量であり小さいため、

ウェハ６の表面の凸部及び凹部の面積が大きい場合においても、段差をなくすことができる。

【００２９】次に、研磨バッド２と研磨テーブル１との間の空間にポンプにより流通孔５を介して圧力流体４が供給される。これにより、研磨バッド２の表面の変形量が大きくなるように弾性特性を変化させることができる。この状態の研磨装置を使用してウェハ６の研磨を行なう。これにより、同様にウェハ６の表面が研磨されるが、研磨バッド２の表面の変形量は研磨バッド２自体の弾性変形量と圧力流体４の変形量との和であり大きいため、研磨量のバラツキを小さくすることができる。なお、圧力流体の供給量及び供給圧力を変化させることにより、研磨バッド２の表面の変形量は変化する。即ち、研磨バッドの弾性特性は変化する。

【００３０】このように、本実施例においては、１個の研磨テーブルが設けられた研磨装置を使用して、研磨バッドを交換することなく研磨バッドの弾性特性を変化させることができる。このため、先ず、段差をなくすように研磨して、次に、バラツキを小さくして研磨することにより、ウェハ６の表面に段差を残すことなく平坦化することができる。

【００３１】なお、本実施例においては、研磨バッドを研磨テーブルに密着させることにより研磨バッド２の表面の変形量を小さくしてウェハの研磨を行なっているが、本発明においては、これに限らず、研磨バッド２を研磨テーブル１に密着させることなく、圧力流体の供給量又は供給圧力を小さくすることにより、研磨バッド２の表面の変形量を小さくしてウェハの研磨を行なってもよい。

【００３２】

【発明の効果】以上詳述したように、本発明によれば、弾性特性の異なる研磨バッドに交換したり研磨バッドと研磨テーブルとの間に他のバッドを設けるといった手間をかけることなく、研磨バッドの弾性特性を変化させることができる。これにより、先ず、研磨バッドの表面の変形量が小さい状態で研磨を行ない、次に、研磨バッドの表面の変形量が大きい状態で研磨を行なうことにより、半導体ウェハの表面に段差を残すことなく平坦化することができる。

【図面の簡単な説明】

【図１】本発明の実施例に係る研磨装置を示す断面図である。

【図２】本発明の実施例に係る研磨装置を示す図であって、（ａ）は圧力流体が供給された状態を示す断面図、（ｂ）は研磨バッドが研磨テーブルに密着した状態を示す断面図である。

【図３】従来の第１の研磨装置を示す模式図である。

【図４】ウェハを示す図であって、（ａ）は研磨前の状態を示す断面図、（ｂ）は研磨後の状態を示す断面図である。

【図５】従来の第２の研磨装置を示す断面図である。

【図６】従来の第２の研磨装置を使用したときの研磨量のバラツキ量を示すグラフ図である。

【図７】（ａ）乃至（ｃ）はウェハの研磨過程を示す断面図である。

【図８】従来の第２の研磨装置を使用したときの凸部の段差の大きさを示すグラフ図である。

【図９】下層バッドが設けられていない研磨装置を示す断面図である。

【図１０】図９に示す研磨装置を使用したときの凸部の段差の大きさを示すグラフ図である。

【図１１】図９に示す研磨装置を使用したときの研磨量のバラツキ量を示すグラフ図である。

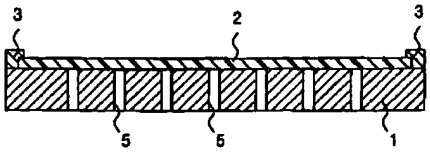
【図１２】下層バッドが設けられていない研磨装置及び下層バッドが設けられた研磨装置の両方を使用したときの凸部の段差の大きさを示すグラフ図である。

【図１３】下層バッドが設けられていない研磨装置及び下層バッドが設けられた研磨装置の両方を使用したときの研磨量のバラツキ量を示すグラフ図である。

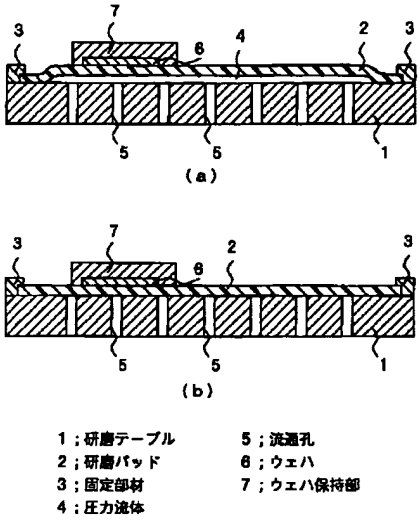
【符号の説明】

１；研磨テーブル
２；研磨バッド
３；固定部材
４；圧力流体
５；供給孔
６；ウェハ
７；ウェハ保持部
８；研磨剤
９；下層バッド
１０；凸部
１１；凹部
１２；大面積の凸部
１３；大面積の凹部
１４；半導体基板
１５；配線
１６；層間絶縁膜
１８；研磨剤供給管

【図１】

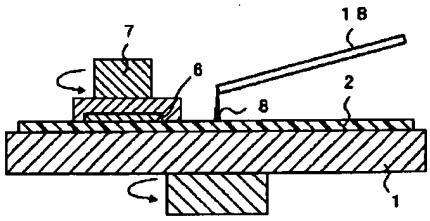



【図２】

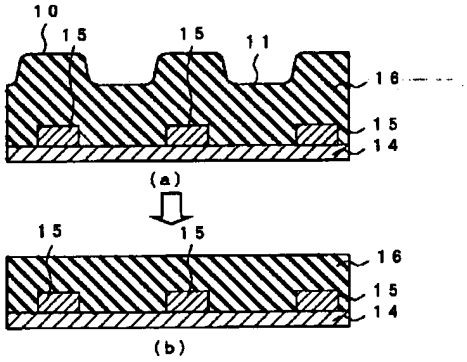



1；研磨テーブル　　5；流通孔
2；研磨パッド　　6；ウェハ
3；固定部材　　7；ウェハ保持部
4；圧力流体

【図３】

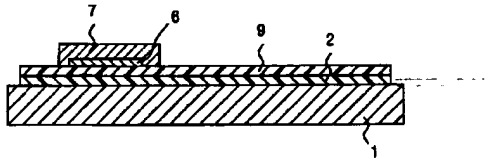



【図４】

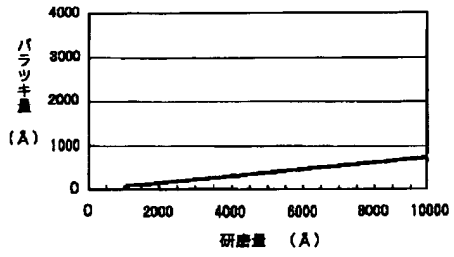



1；研磨テーブル　　11；凹部
2；研磨パッド　　14；半導体基板
6；ウェハ　　15；配線
7；ウェハ保持部　　16；層間絶縁膜
8；研磨剤　　18；研磨剤供給管
10；凸部

【図５】

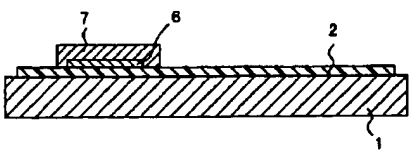



【図６】

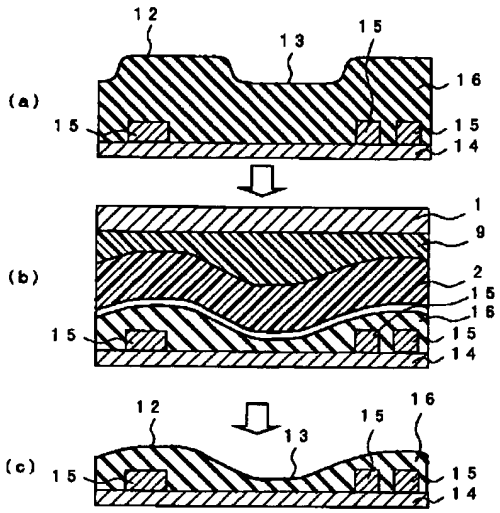



1；研磨テーブル
2；研磨パッド
6；ウェハ
7；ウェハ保持部
9；下層パッド

【図９】

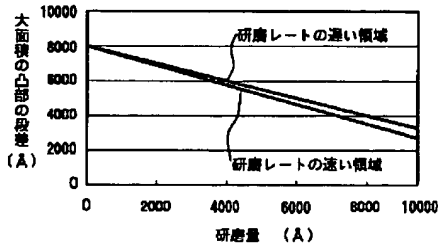


【図７】

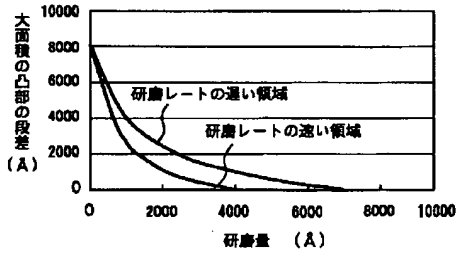



１；研磨テーブル　　１３；大面積の凹部
２；研磨パッド　　１４；半導体基板
９；下層パッド　　１５；配線
１２；大面積の凸部　　１６；層間絶縁膜

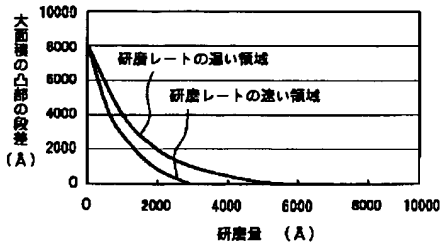
【図８】




【図１２】

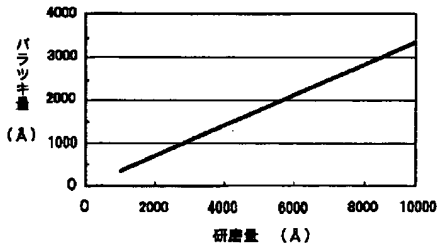



【図１０】

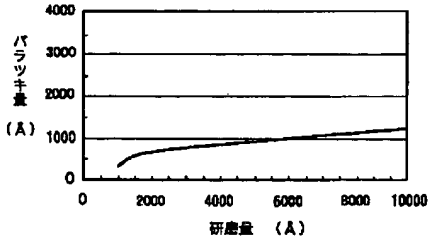



１；研磨テーブル　　６；ウェハ
２；研磨パッド　　７；ウェハ保持部

【図１１】




【図１３】



【手続補正書】
【提出日】平成１１年１２月６日（１９９９．１２．６）
【手続補正１】
【補正対象書類名】明細書
【補正対象項目名】特許請求の範囲
【補正方法】変更
【補正内容】
【特許請求の範囲】
【請求項１】　研磨テーブル上に設けられた研磨パッドの表面と半導体ウェハの表面とを接触させながら相対運動させることにより前記半導体ウェハの表面の平坦化を行なう研磨装置において、前記研磨パッドの周縁部を除く部分と前記研磨テーブルとの間の全域に空間を形成するように前記研磨パッドの縁部と前記研磨テーブルとを密着させる手段と、前記空間内に圧力流体を供給する流体供給手段と、を有することを特徴とする研磨装置。
【請求項２】　前記研磨テーブルに流通孔が形成されており、この流通孔を介して前記流体が前記空間内に供給されることを特徴とする請求項１に記載の研磨装置。
【請求項３】　前記研磨パッドの縁部と前記研磨テーブルとを密着させる手段は前記研磨パッドの縁部と前記研磨テーブルとを握持して固定する握持部材であることを特徴とする請求項１又は２に記載の研磨装置。
【請求項４】　前記研磨テーブルの前記流通孔を介して前記研磨パッドを前記研磨テーブルに向けて直接吸引し前記研磨パッドを前記研磨テーブルに密着させる吸引手段を有することを特徴とする請求項１乃至３のいずれか１項に記載の研磨装置。
【請求項５】　前記研磨テーブルは鉛直軸中心に回転可能に設けられていることを特徴とする請求項１乃至４のいずれか１項に記載の研磨装置。
【請求項６】　前記半導体ウェハを保持し鉛直軸中心に回転可能なウェハ保持部が設けられていることを特徴とする請求項１乃至５のいずれか１項に記載の研磨装置。
【手続補正２】
【補正対象書類名】明細書
【補正対象項目名】０００４
【補正方法】変更
【補正内容】
【０００４】また、図４（ａ）に示すように、研磨前のウェハは半導体基板１４上に選択的に配線１５が形成されその全面に層間絶縁膜１６が形成されたものであり、層間絶縁膜１６の上面においては、配線１５が形成された部分に対応する領域に凸部１０が形成され、配線１５が形成されない部分に対応する領域に凹部１１が形成されている。
【手続補正３】
【補正対象書類名】明細書
【補正対象項目名】００２０
【補正方法】変更
【補正内容】
【００２０】
【課題を解決するための手段】本発明に係る研磨装置は、研磨テーブル上に設けられた研磨パッドの表面と半導体ウェハの表面とを接触させながら相対運動させることにより前記半導体ウェハの表面の平坦化を行なう研磨装置において、前記研磨パッドの周縁部を除く部分と前記研磨テーブルとの間の全域に空間を形成するように前記研磨パッドの縁部と前記研磨テーブルとを密着させる手段と、前記空間内に圧力流体を供給する流体供給手段と、を有することを特徴とする。
【手続補正４】
【補正対象書類名】明細書
【補正対象項目名】００２２
【補正方法】変更
【補正内容】
【００２２】更に、前記研磨テーブルの前記流通孔を介して前記研磨パッドを前記研磨テーブルに向けて直接吸引し前記研磨パッドを前記研磨テーブルに密着させる吸引手段が設けられていると好ましい。
【手続補正５】
【補正対象書類名】明細書
【補正対象項目名】００２８
【補正方法】変更
【補正内容】
【００２８】このように構成された本実施例の研磨装置においては、先ず、図２（ｂ）に示すように、ポンプを使用して研磨パッド２を研磨テーブル１に向けて直接吸引し、研磨パッド２を研磨テーブル１に密着させる。これにより、研磨パッド２の表面の変形量が最も小さくなるように弾性特性を変化させることができる。この状態の研磨装置を使用してウェハ６の研磨を行なう。具体的には研磨テーブル１と共に回転する研磨パッド２の上面に研磨剤供給管から研磨剤が滴下される。そして、ウェハ６を保持したウェハ保持部７が回転しながらウェハ６を研磨パッド２に押し付ける。これにより、ウェハ６の表面が研磨される。このとき、研磨パッド２の表面の変形量は研磨パッド２自体の弾性変形量であり小さいため、ウェハ６の表面の凸部及び凹部の面積が大きい場合においても、段差をなくすことができる。
【手続補正６】
【補正対象書類名】明細書
【補正対象項目名】００２９
【補正方法】変更
【補正内容】
【００２９】次に、研磨パッド２と研磨テーブル１との間の空間にポンプにより流通孔５を介して圧力流体４が供給される。これにより、研磨パッド２の表面の変形量

が大きくなるように弾性特性を変化させることができる。この状態の研磨装置を使用してウェハ６の研磨を行なう。これにより、同様にウェハ６の表面が研磨されるが、研磨パッド２の表面の変形量は研磨パッド２自体の弾性変形量と圧力流体４の変形量との和であり大きいため、研磨量のバラツキを小さくすることができる。なお、圧力流体４の供給量及び供給圧力を変化させることにより、研磨パッド２の表面の変形量は変化する。即ち、研磨パッド２の弾性特性は変化する。

【手続補正７】
【補正対象書類名】明細書
【補正対象項目名】００３０
【補正方法】変更
【補正内容】
【００３０】このように、本実施例においては、１個の研磨テーブル１が設けられた研磨装置を使用して、研磨パッド２を交換することなく研磨パッド２の弾性特性を変化させることができる。このため、先ず、段差をなくすように研磨して、次に、バラツキを小さくして研磨することにより、ウェハ６の表面に段差を残すことなく平坦化することができる。

【手続補正８】
【補正対象書類名】明細書
【補正対象項目名】００３１
【補正方法】変更
【補正内容】
【００３１】なお、本実施例においては、研磨パッド２を研磨テーブル１に密着させることにより研磨パッド２の表面の変形量を小さくしてウェハの研磨を行なっているが、本発明においては、これに限らず、研磨パッド２を研磨テーブル１に密着させることなく、圧力流体４の供給量又は供給圧力を小さくすることにより、研磨パッド２の表面の変形量を小さくしてウェハの研磨を行なってもよい。

## DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the suitable polishing equipment for a chemical mechanical-polishing method especially about the polishing equipment of a semiconductor device.
[0002]
[Description of the Prior Art] planarizing processes, such as an interlayer film in the manufacturing process of a semiconductor integrated circuit, -- CMP (chemical mechanical polishing: Chemical Mechanical Polishing) -- the case where the technology of law is used has increased. Since an exposure margin becomes small by short wavelength-ization with the conventional optical exposure technology in order to form a detailed pattern with contraction-izing of the design rule of a semiconductor integrated circuit, and it becomes easy to be influenced of the level difference on the upper surface of a semiconductor integrated circuit, it is because the technology of perfect flattening of a semiconductor integrated circuit is needed. Drawing 3 is the mimetic diagram showing the 1st conventional polishing equipment. Moreover, drawing 4 is drawing showing a wafer, and the cross section in which (a) shows the condition before polishing, and (b) are the cross sections showing the condition after polishing.
[0003] As shown in drawing 3 , in the 1st conventional polishing equipment, it consists of the rigid body and the scouring pad 2 which consists of firing polyurethane is being fixed to the upper surface of the pivotable polishing table 1 focusing on the vertical axis. Moreover, the wafer attaching part 7 which can push a wafer 6 against a scouring pad 2 is formed, rotating focusing on a vertical axis, while holding the wafer 6 for polishing. Moreover, the abrasive material supply pipe 18 which trickles an abrasive material 8 is formed above the scouring pad 2.
[0004] Moreover, the crevice 11 is formed in the field corresponding to the portion in which wiring 15 is formed in alternatively [ the wafer before polishing ] to semiconductor substrate top 14, an interlayer insulation film 16 is formed in all over the, heights 10 are formed in the field corresponding to the portion in which wiring 15 was formed, and wiring 15 is not formed on the upper surface of an interlayer insulation film 16 as shown in drawing 4 (a).
[0005] Thus, in the 1st constituted conventional polishing equipment, an abrasive material 8 is dropped at the upper surface of the scouring pad 2 which rotates with the polishing table 1 from the abrasive material supply pipe 18. And a wafer 6 is pushed against a scouring pad 2 while the wafer attaching part 7 holding a wafer 6 rotates. Thereby, the heights 10 and the crevice 11 of a wafer on top which are shown in drawing 4 (a) are ground. In order for a high pressure to join heights 10 from a crevice 11 at this time, there are more amounts by which the direction of heights 10 is ground than a crevice 11, soon, as shown in drawing 4 (b), the level difference of the heights 10 of the upper surface of an interlayer insulation film 16 and a crevice 11 is lost, and flattening is carried out.
[0006] However, the polishing rate within a wafer side (it is also called the amount of polishing per [ which broke by polishing time amount the amount of polishing when carrying out fixed time amount polishing of the wafer with which the pattern is not formed ] unit time amount, and polishing speed) changes with locations within a wafer side, and a field with many amounts of polishing per unit time amount and few fields produce it. In addition, each field is called the field where a polishing rate is quick, and field where a polishing rate is late. Although based also on polishing conditions, the center section of a wafer is specifically the field where a polishing rate is late, and the periphery section of a wafer is a field where a polishing rate is quick.
[0007] Moreover, the difference of the polishing peak and polishing minimal dose within the wafer side when grinding the wafer with which the pattern is not formed, i.e., the difference of the amount of polishing produced between the field where a polishing rate is quick, and a late field, is called variation in the amount of polishing. In order to make small variation in the thickness of the insulating-layer mesenteriolum which remains on a wafer, it is desirable for the variation in the amount of polishing within a wafer side to be small. In order to make small variation in this amount of polishing, there is polishing equipment with which the elastic lower layer pad was prepared between the polishing table and the scouring pad (JP,8-132342,A). Drawing 5 is the cross section showing the 2nd conventional polishing equipment, and drawing 6 is the graphical representation showing the amount of variations of the amount of polishing when using the 2nd conventional polishing equipment. Moreover, drawing 7 (a) thru/or (c) are the cross sections showing the polishing process of a wafer, and drawing 8 is the graphical representation showing the magnitude of the level difference of the heights when using the 2nd conventional polishing equipment.
[0008] As shown in drawing 5 , in the 2nd conventional polishing equipment, the elastic lower layer pad 9 is formed from the scouring pad 2 between the polishing table 1 and the scouring pad 2. The other configuration is the same as that of the 1st conventional polishing equipment, and omits explanation.

[0009] Thus, when using the 2nd constituted conventional polishing equipment and grinding a wafer 6, the deformation of the surface of a scouring pad 2 becomes the sum of the elastic deformation of a scouring pad 2, and the deformation of a lower layer pad. For this reason, since the deformation of the surface of a scouring pad 2 becomes large and the surface of a scouring pad 2 can follow in footsteps to deformation of the wafer 6 whole, such as curvature, as shown in drawing 6 , the amount of variations of the amount of polishing within a wafer side can be ground small. In addition, the "amount of polishing" shown on a graph horizontal axis is a value set as polishing equipment, in order to grind the wafer with which the pattern is not formed, and it is hereafter called the amount of conversion polishing. For example, if the wafer with which the pattern is not formed in the amount of conversion polishing of 6000A is ground, the amount of polishing will become 6000A, and when, grinding the wafer with which irregularity was formed in the surface on the other hand, in order for many pressures to join the heights, 6000A or more (for example, 8000A) polishing of the heights is carried out. The "amount of polishing" shown on the horizontal axis of the graphical representation after this shows the amount of conversion polishing altogether mentioned above.
[0010] However, while heights 12 will be ground since the deformation of the surface of a scouring pad 2 follows in footsteps of a large configuration with the detailed surface of a wafer if it grinds using the 2nd conventional polishing equipment to the wafer with which the large heights 12 and the heights 13 of area were formed in the wafer upper surface as shown in drawing 7 (a) thru/or (c), considerable-amount polishing also of the crevice 13 is carried out. For this reason, if 8000A conversion polishing is performed to the wafer which has the level difference of 8000A as shown in drawing 8 for example, the level difference of about 4000A will remain in the wafer surface after polishing processing.
[0011] On the other hand, there is polishing equipment (henceforth the 3rd conventional polishing equipment) indicated by JP,9-97772,A similarly as polishing equipment aiming at raising the homogeneity of polishing speed (polishing rate). The minute bag (air cell) of a large number which put pressure flow objects, such as air, into the interior is prepared between pivotable surface plates made from SUS and scouring pads, and this 3rd conventional polishing equipment can control the deformation on the surface of a scouring pad partially. However, in the 3rd conventional polishing equipment, if the field which does not have to carry out remainder polishing like a crevice grinds to a large wafer while a part like heights to carry out flattening is large, a level difference will remain in the wafer surface after polishing processing. In order to prevent this level difference remainder, it is necessary to avoid layout of a wafer which was mentioned above and by which flattening is not carried out, and the layout flexibility of a wafer becomes low.
[0012] In order to solve the trouble in the 2nd conventional polishing equipment and the 3rd polishing equipment which were mentioned above, the polishing equipment with which the lower layer pad shown in drawing 9 is not prepared can be used. Drawing 9 is the cross section showing the polishing equipment with which the lower layer pad is not prepared, and drawing 10 is the graphical representation showing the magnitude of the level difference of the heights when using the polishing equipment shown in drawing 9 . Drawing 11 is the graphical representation showing the amount of variations of the amount of polishing when using the polishing equipment shown in drawing 9 .
[0013] In the polishing equipment shown in drawing 9 , since it is constituted so that it may stick to the polishing table 1 on which a scouring pad 2 consists of the rigid body, the deformation of the surface of a scouring pad 2 is small. For this reason, since the surface of a scouring pad 2 does not follow in footsteps of a configuration with the detailed surface of a wafer, unlike the 2nd conventional polishing equipment and the 3rd polishing equipment, the amount by which the crevice 13 of a large area is ground becomes small enough, and it can prevent that a level difference remains in the wafer surface. For this reason, as shown in drawing 10 , the level difference of heights can be lost in the small amount of conversion polishing.
[0014] On the other hand, since the surface of a scouring pad 2 cannot follow in footsteps to deformation of the wafer 6 whole, such as curvature, as shown in drawing 11 , the amount of variations of the amount of polishing becomes large as compared with the 2nd conventional polishing equipment with which the lower layer pad was prepared. For example, when 6000A conversion polishing is performed, the amount of variations of the amount of polishing exceeds 2000A, until the level difference formed in the field where a polishing rate is late is lost.
[0015] From having mentioned above, grind first with the polishing equipment with which the wafer is not prepared in the lower layer pad, and a level difference is made small within limits by which the amount of variations within a wafer side is permitted. Next, the method of making a level difference small, i.e., the method of grinding using the scouring pad with which elasticity differs (using properly), can be further considered in the condition that the amount of variations within a wafer side is small, by grinding with the polishing equipment with which lower layer Bud was prepared. Drawing 12 is the graphical representation showing the magnitude of the level difference of the heights when using both polishing equipments with which the polishing equipment and the lower layer pad with which the lower layer pad is not prepared were prepared. Drawing 13 is the graphical representation showing the amount of variations of the amount of polishing when using both polishing equipments with which the polishing equipment and the lower layer pad with which the lower layer pad is not prepared were prepared.
[0016] For example, if it grinds with the polishing equipment with which lower layer Bud was prepared after the polishing equipment with which the wafer is not prepared in the lower layer pad performs 2000A conversion polishing first, as shown in drawing 12 While being able to lose a level difference in the amount of conversion polishing of 8000A also to the wafer with which the heights and the crevice of the large area which has the level difference of 8000A were formed As shown in drawing 13 , as compared with the case (refer to drawing 11 ) where only the polishing equipment with which the lower layer pad is not prepared is used, the amount of variations of the amount of polishing can be made small.
[0017]
[Problem(s) to be Solved by the Invention] however, in the method mentioned above, since elasticity needs a scouring pad different, respectively, when using one polishing equipment, the scouring pad with which elasticity differs is exchanged and it corresponds -- ******** (elasticity can be changed by changing the hardness of the scouring pad itself or choosing the existence of use of a lower

layer pad) -- there is a trouble that exchange of a scouring pad takes time and effort.
[0018] On the other hand, when using two polishing equipments, the area which equipment installation takes has the trouble of being required, by two sets. Although it can also respond using the polishing equipment with which two or more polishing tables were prepared, the area which equipment installation takes also in this case is not more widely [ than one set ] desirable.
[0019] This invention is made in view of this trouble, and the polishing equipment with which one polishing table was prepared is used, and it aims at offering the polishing equipment to which the elasticity of a scouring pad can be changed, without exchanging scouring pads.
[0020]
[Means for Solving the Problem] Polishing equipment concerning this invention is polishing equipment which performs flattening of the surface of said semiconductor wafer by carrying out relative motion, contacting the surface of a scouring pad and the surface of a semiconductor wafer which were prepared on a polishing table. It is characterized by having a means to stick a edge and said polishing table of said scouring pad so that space may be formed between said scouring pads and said polishing tables, and a fluid supply means to supply a pressure flow object in said space.
[0021] A circulation hole is formed in said polishing table, and said fluid can make it a configuration supplied in said space through this circulation hole. Moreover, a means to stick a edge and said polishing table of said scouring pad can be used as a support member which supports a edge and said polishing table of said scouring pad, and is fixed.
[0022] Furthermore, it is desirable when a suction means to turn said scouring pad to said polishing table, to attract it through said circulation hole of said polishing table, and to stick said scouring pad on said polishing table is established.
[0023] Furthermore, said polishing table may be prepared pivotable focusing on the vertical axis, said semiconductor wafer is held and a pivotable wafer attaching part may be prepared again focusing on the vertical axis.
[0024] In this invention, a pressure flow object can be supplied in a scouring pad, a polishing table, and space of a between using a fluid supply means. For this reason, when performing flattening of the surface of a semiconductor wafer by carrying out relative motion, contacting the surface of a scouring pad, and the surface of a semiconductor wafer, elasticity in the surface of a scouring pad can be changed by changing the amount of supply or a supply pressure of a pressure flow object. Therefore, without applying time and effort of exchanging for a scouring pad with which elasticity differs, or preparing other pads between a scouring pad and a polishing table, it can grind in the condition that deformation of the surface of a scouring pad is small, first, next deformation of the surface of a scouring pad can grind in the large condition. For this reason, flattening can be carried out by grinding first, so that a level difference may be lost, next making variation small and grinding it, without leaving a level difference to the surface of a semiconductor wafer.
[0025] Moreover, if a suction means to turn a scouring pad to a polishing table, to attract it through a circulation hole of a polishing table, and to stick a scouring pad on a polishing table is established, a scouring pad can be stuck on a polishing table with this suction means, and, thereby, it can change into the condition that the surface of a scouring pad cannot deform the elasticity of a scouring pad most easily.
[0026]
[Embodiment of the Invention] Hereafter, the polishing equipment concerning the example of this invention is concretely explained with reference to an attached drawing. Drawing 1 is the cross section showing the polishing equipment concerning the example of this invention. Drawing 2 is drawing showing the polishing equipment concerning the example of this invention, and they are the cross section in which (a) shows the condition that the pressure flow object was supplied, and the cross section in which, as for (b), a scouring pad shows the condition of having stuck to the polishing table. As shown in drawing 1 and 2, in the polishing equipment of this example, it consists of the rigid body and the scouring pad 2 is formed in the upper surface of the pivotable polishing table 1 focusing on the vertical axis. The edge and the polishing table 1 of this scouring pad 2 are being fixed so that it may be supported by the holddown member 3 and a fluid may not leak. That is, when a fluid is supplied to the space surrounded by the polishing table 1 and the scouring pad 2, a fluid leaks from the edge of a scouring pad 2. Moreover, the wafer attaching part 7 which can push a wafer 6 against a scouring pad 2 is formed, rotating focusing on a vertical axis, while holding the wafer 6 for polishing. Moreover, the abrasive material supply pipe (neither is illustrated) which trickles an abrasive material is formed above the scouring pad 2.
[0027] Furthermore, as shown in drawing 2 (a), two or more circulation holes 5 are formed in the polishing table 1, the pipe (neither is illustrated) connected to the pump is prepared in this circulation hole 5, and the amount of arbitration or the pressure flow object 4 of a pressure can be supplied now to the space surrounded by the scouring pad 2 and the polishing table 1 through a pipe and the circulation hole 5 from a pump. Moreover, the pressure flow object 4 is sampled through the circulation hole 5 and a pipe, further, a scouring pad 2 can be turned to the polishing table 1, and can be attracted, and it can be made to stick to the upper surface, as shown in drawing 2 (b) now.
[0028] Thus, in the polishing equipment of constituted this example, first, as shown in drawing 2 (b), using a pump, a scouring pad 2 is turned to the polishing table 1, and is attracted, and a scouring pad 2 is stuck on the polishing table 1. Elasticity can be changed so that the deformation of the surface of a scouring pad 2 may become the smallest by this. A wafer 6 is ground using the polishing equipment of this condition. An abrasive material is dropped at the upper surface of the scouring pad 2 which specifically rotates with the polishing table 1 from an abrasive material supply pipe. And a wafer 6 is pushed against a scouring pad 2 while the wafer attaching part 7 holding a wafer 6 rotates. Thereby, the surface of a wafer 6 is ground. At this time, the deformation of the surface of a scouring pad 2 is the elastic deformation of scouring pad 2 the very thing, and since it is small, when the area of the heights of the surface of a wafer 6 and a crevice is large, it can lose a level difference.
[0029] Next, the pressure flow object 4 is supplied to the space between a scouring pad 2 and the polishing table 1 through the circulation hole 5 with a pump. Thereby, elasticity can be changed so that the deformation of the surface of a scouring pad 2 may

become large. A wafer 6 is ground using the polishing equipment of this condition. Although the surface of a wafer 6 is ground similarly by this, the deformation of the surface of a scouring pad 2 is the sum of the elastic deformation of scouring pad 2 the very thing, and the deformation of the pressure flow object 4, and since it is large, it can make variation in the amount of polishing small. In addition, the deformation of the surface of a scouring pad 2 changes by changing the amount of supply and the supply pressure of a pressure flow object. That is, the elasticity of a scouring pad changes.

[0030] Thus, in this example, the polishing equipment with which one polishing table was prepared is used, and the elasticity of a scouring pad can be changed, without exchanging scouring pads. For this reason, flattening can be carried out by grinding first, so that a level difference may be lost, next making variation small and grinding it, without leaving a level difference to the surface of a wafer 6.

[0031] In addition, in this example, although deformation of the surface of a scouring pad 2 is made small and the wafer is ground by sticking a scouring pad on a polishing table, in this invention, without sticking not only this but the scouring pad 2 on the polishing table 1, by making small the amount of supply or the supply pressure of a pressure flow object, deformation of the surface of a scouring pad 2 may be made small, and a wafer may be ground.

[0032]

[Effect of the Invention] The elasticity of a scouring pad can be changed without applying the time and effort of exchanging for the scouring pad with which elasticity differs, or preparing other pads between a scouring pad and a polishing table according to this invention, as explained in full detail above. When it grinds in the condition that the deformation of the surface of a scouring pad is small, thereby first, next the deformation of the surface of a scouring pad grinds in the large condition, flattening can be carried out without leaving a level difference to the surface of a semiconductor wafer.

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[Translation done.]

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]
[Drawing 1] It is the cross section showing the polishing equipment concerning the example of this invention.
[Drawing 2] It is drawing showing the polishing equipment concerning the example of this invention, and they are the cross section in which (a) shows the condition that the pressure flow object was supplied, and the cross section in which, as for (b), a scouring pad shows the condition of having stuck to the polishing table.
[Drawing 3] It is the mimetic diagram showing the 1st conventional polishing equipment.
[Drawing 4] It is drawing showing a wafer and the cross section in which (a) shows the condition before polishing, and (b) are the cross sections showing the condition after polishing.
[Drawing 5] It is the cross section showing the 2nd conventional polishing equipment.
[Drawing 6] It is the graphical representation showing the amount of variations of the amount of polishing when using the 2nd conventional polishing equipment.
[Drawing 7] (a) Or (c) is the cross section showing the polishing process of a wafer.
[Drawing 8] It is the graphical representation showing the magnitude of the level difference of the heights when using the 2nd conventional polishing equipment.
[Drawing 9] It is the cross section showing the polishing equipment with which the lower layer pad is not prepared.
[Drawing 10] It is the graphical representation showing the magnitude of the level difference of the heights when using the polishing equipment shown in drawing 9 .
[Drawing 11] It is the graphical representation showing the amount of variations of the amount of polishing when using the polishing equipment shown in drawing 9 .
[Drawing 12] It is the graphical representation showing the magnitude of the level difference of the heights when using both polishing equipments with which the polishing equipment and the lower layer pad with which the lower layer pad is not prepared were prepared.
[Drawing 13] It is the graphical representation showing the amount of variations of the amount of polishing when using both polishing equipments with which the polishing equipment and the lower layer pad with which the lower layer pad is not prepared were prepared.
[Description of Notations]
1; polishing table
2; scouring pad
3; holddown member
4; pressure flow object
5; feed holes
6; wafer
7; wafer attaching part
8; abrasive material
9; lower layer pad
10; heights
11; crevice
12; heights of a large area
13; the crevice of a large area
14; semiconductor substrate
15; wiring
16; interlayer insulation film
18; abrasive material supply pipe

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[Translation done.]

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CLAIMS

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[Claim(s)]
[Claim 1] The polishing equipment characterized by to have a means stick the edge and said polishing table of said scouring pad in the polishing equipment which performs flattening of the surface of said semiconductor wafer by carrying out relative motion so that space may form between said scouring pads and said polishing tables while contacting the surface of a scouring pad and the surface of a semiconductor wafer which were prepared on a polishing table, and a fluid supply means supply a pressure-flow object in said space.
[Claim 2] Polishing equipment according to claim 1 characterized by forming a circulation hole in said polishing table, and supplying said fluid in said space through this circulation hole.
[Claim 3] A means to stick a edge and said polishing table of said scouring pad is polishing equipment according to claim 1 or 2 characterized by being the support member which supports a edge and said polishing table of said scouring pad, and is fixed.
[Claim 4] Polishing equipment given in claim 1 characterized by having a suction means to turn said scouring pad to said polishing table, to attract it through said circulation hole of said polishing table, and to stick said scouring pad on said polishing table thru/or any 1 term of 3.
[Claim 5] Said polishing table is polishing equipment given in claim 1 characterized by being prepared pivotable focusing on a vertical axis thru/or any 1 term of 4.
[Claim 6] Polishing equipment given in claim 1 characterized by holding said semiconductor wafer and preparing a pivotable wafer attaching part focusing on a vertical axis thru/or any 1 term of 5.

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[Translation done.]